Assembly Manual

PC-Driven Video Text Overlay Module

Cat No: **K 5417**

by James Barker

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KIT

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Here is a project that is able to overlay text material onto existing video signals. The project takes advantage of a new multifunction chip from ST Microelectronics designed expressly for this type of application, the STV5730A. In this case the chip is used in a 'bare bones' configuration which allows its operation to be controlled from a PC, via the printer port. This makes it very flexible, in terms of what it can display.

FOR MANY YEARS, I have seen 'typewriter text' superimposed on television images. Since I joined an amateur TV club over five years ago, I have been trying non-stop to use similar technology to superimpose an amateur television callsign identifier on the video signal for ATV transmissions — as an alternative to the 'low tech' solution: a piece of cardboard on a string from the roof of the radio shack.

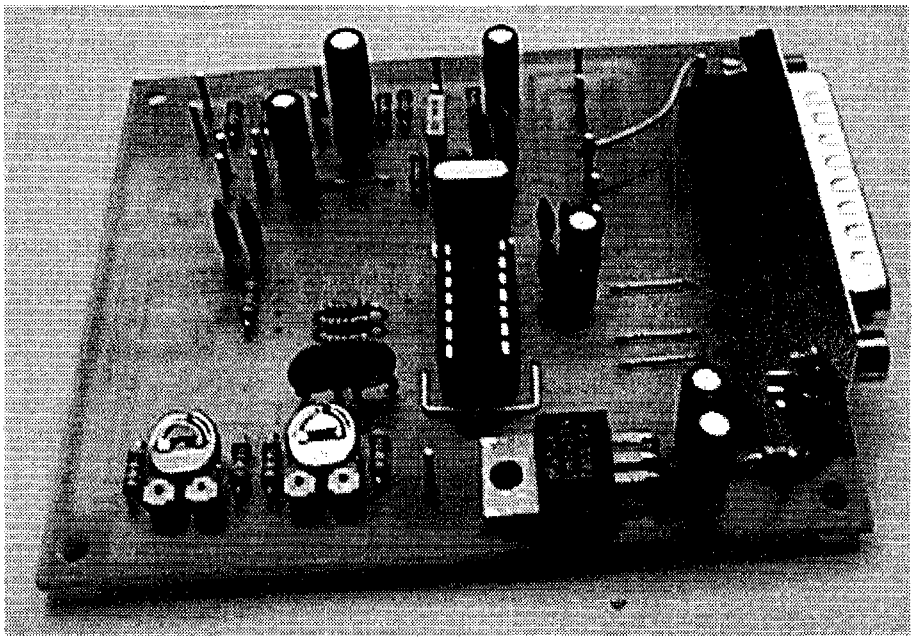
At first I tried a circuit using the fairly common LM1881 sync separator chip, an EPROM and a TEA2000 video encoder. It worked, but gave rather 'chunky' characters.

After searching and trying a few other circuits, I recently stumbled over the STV5730 integrated circuit, from ST Microelectronics. This is a fairly new chip, especially designed for the job of producing on-screen menues and other displays for VCRs, Pay TV set-top boxes, DVD players, satellite TV receivers and so on. It's a very powerful chip, containing just about all of the circuitry needed for on-screen text displays locked to an existing video signal.

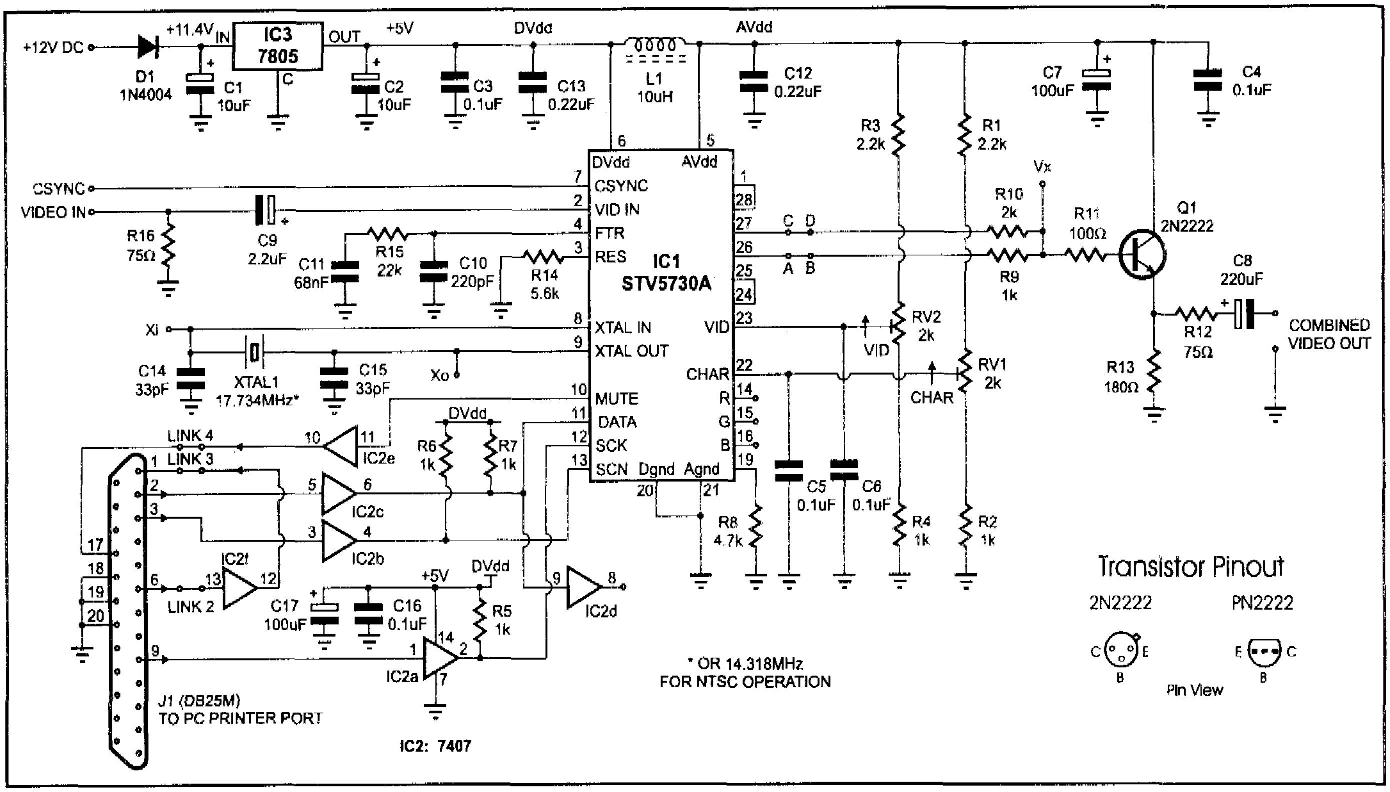
I found a Technical Note for STV5730 on the ST Microelectronics web site, which gave a simple PC-driven circuit for evaluation — plus some downloadable software to get you going. Voila! So I wasted no time in designing a PCB to try it out, using the tech note circuit as a good starting place.

Unfortunately by the time I'd finished the board pattern, I found out that the original DIL-package version of the IC was no longer available, having been replaced by a 28-pin surface mount device — the STV5730A. So the PCB artwork was hastily redrawn, I had a couple of prototype boards made and these were used to build up my prototypes. And suddenly I had what I've always wanted: a really simple, low cost way to put text onto a video image.

Now my own aim in developing this project has been to provide amateur television operators with a very economical way of putting their callsign on the



The module should be housed in a suitable case with video (input and output connectors) mounted on the case panel.



Considering what the project does, the schematic is surprisingly simple. The secret is what's inside IC1, a very powerful dedicated on-screen display processor.

transmitted picture, to satisfy certain radio regulations and allow others to be aware of who's who when 'on air'. However after using it for a while I'm now aware that it would have various other uses as well, such as allowing you to add simple on-screen text to video for transfers, archive recording and so on.

It's true that various commercial 'TV typewriters' have become available over the last few years, with prices gradually dropping from about $2000 down to $500. But this is still a rather expensive kind of gadget to use just for callsign ID or adding ID 'headers' to tape copies or archive tapes.

This little On-Screen Display or 'OSD' project will cost you a heck of a lot less and allows you to use your PC as a TV typewriter, with a surprising amount of flexibility. It simply hooks up to the PC via a standard Centronics parallel printer port, as found on virtually any old PC you might want to use.

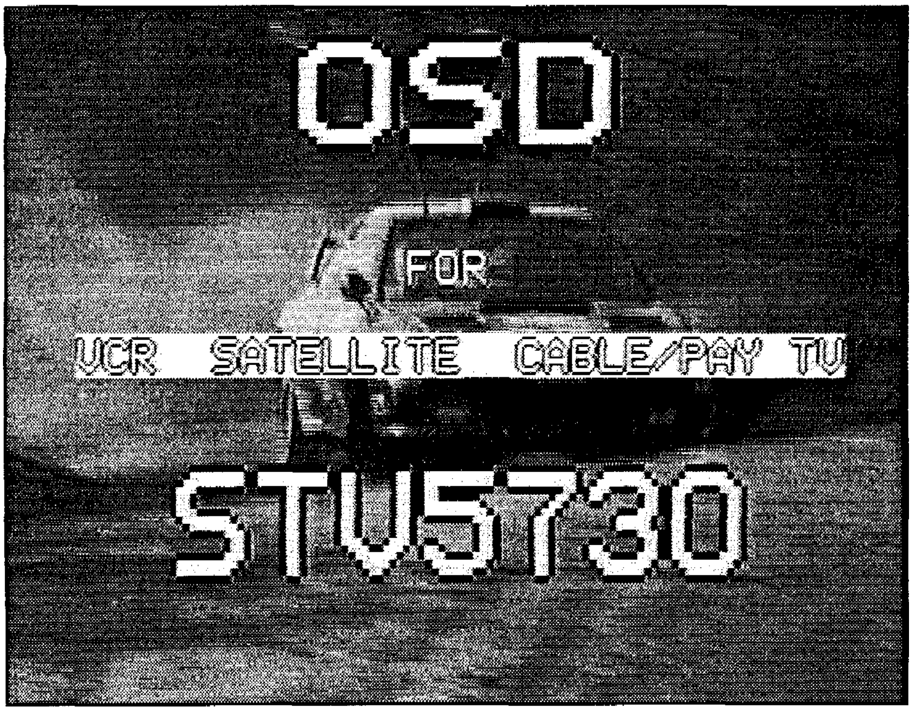


Fig.1: Here's the display you should get using the demo software to download DEMO1.DAT into the module. The bottom line should be blinking.

At this stage I haven't been able to develop special software for the PC to take full advantage of the STV5730A's features and flexibility, or make it easier to prepare on-screen messages. So that this stage it's really a matter of using the 'freeware' demo software developed by ST Microelectronics, and downloadable from their website (and hopefully from the *Electronics Australia* website), to at least get you going.

This demo software is a bit clunky, but those of you who are good at programming will find quite a lot of info on the STV5730A's commands and how its registers are accessed, in the STV5730 Tech Note and data sheet. These are both downloadable from their web site, and I'm sure a hotshot programmer will be able to use the info to produce a really impressive TV Typewriter program.

What's possible

The basic capabilities of the STV5730A are to display 11 rows of text, each with the capacity of up to 28 characters per line in 'zoom 1' mode. Zoom mode 2 means a couple of rows at 14 characters per line; zoom mode 3 means that the characters are three lines high, and finally zoom mode 4 has characters four lines high. All this means is that you can get larger characters — at a price in terms of fewer characters per line, and fewer lines on the image.

Parts list

Resistors

All 0.25W 1% metal film, unless specified:

R1,3	2.2k
R2,4,5,6,7,9	1k
R8	4.7k
R10	2k
R11	100 ohms
R12,16	75 ohms
R13	180 ohms
R14	5.6k
R15	22k
RV1,2	2k horizontal trimpot

Capacitors

C1,2	10uF 25 / 50VW RB electrolytic
C3,4,5,6,16	0.1uF ceramic
C7,17	100uF 16 / 25VW RB electrolytic
C8	220uF 16 / 25VW RB electrolytic
C9	2.2uF 50 / 100VW RB electrolytic
C10	220pF ceramic
C11	68nF MKT
C12,13	0.22uF ceramic
C14,15	33pF NPO ceramic

Semiconductors

IC1	STV5730A OSD chip (SMD)
IC2	7407 hex buffer
IC3	7805 / LM340T-5 (+5V regulator)
Q1	2N2222 / 2N3242 / BSW64 / 2N3569 / 2N3302
D1	1N4004 or similar power diode

Miscellaneous

XTAL1	17.734MHz crystal*
L1	10uH RF choke
J1	DB25M PCB-mount connector

PCB, 96 x 80mm coded 990sd8 (ZA1094); PCB terminal pins ; connecting wires (tin copper) for video input/output, BNC sockets, IC socket, solder, disk with demo software and instruction.

You have a choice of eight basic character colours, while each character, line or screen of text can be given other 'attributes': it can blink; be transparent, translucent, or opaque, etc. You can also do other tricks like turn the background on or off, give a line a vertical or horizontal offset, or of course vary the line's zoom level. These are just some of the possibilities.

Basically the STV5730 comes with a built-in 'font' of 128 characters, stored in ROM. These include the full upper case (capitals) and lower case letters, the numerals 0-9, basic punctuation marks, various European variations of upper and lower case letters, and a selection of special symbol and 'dingbat' characters like arrows, six crude graphics block characters, a heart, a clock face and a tiny 'satellite antenna'.

All of these characters are based on an 18 x 12 pixel matrix, so they're much cleaner than the usual 'CGA' (7 x 5) or 'VGA' (11 x 6) characters. In fact they're even better than the usual SVGA fonts, which are based on an 18 x 10 format. They're basically in a clean and uncluttered 'sans serif' font, rather like the 'Helvetica' or 'Arial' font you find in many Windows computers.

The bottom line is that this IC can do all kinds of tricks; it's very flexible. Hopefully more can be published about its capabilities in the coming months.

How it works

I'm not proposing to go into a lot of detail about how the project works, because it's really all centred around the STV5730A wonder chip — and that's pretty complex, inside. The rest of the circuitry is really just to provide it with power and clock signals, get video into and out of it, set its operating conditions and allow your PC to squirt text into it for display on the screen.

Referring to the schematic, video from your camera or VCR is fed into the STV5730A (IC1) via coupling cap C9, with 75Ω resistor R16 giving the right termination. The chip is also supplied with +5V DC via two different supply pins — pin 6 feeding its internal digital circuitry, and pin 5 the analog circuitry. As you can see pin 6 is fed directly from regulator IC3, while pin 5 is fed via a 10uH RF choke — which also supplies the video output buffer Q1.

Although IC1 uses an internal phase-locked loop (PLL) to derive many of its timings from the incoming video (a built-in 'genlock'), it also needs a clock signal. This has to be at four times the TV colour subcarrier frequency, so for PAL it has to be at 17.734MHz. (The chip can also be used for NTSC, by changing the clock to 14.318MHz — so this is a truly 'multinational' project.)

As the chip has the makings of a clock oscillator inside, all we need to get the clock signal is hang a suitable crystal between pins 8 and 9 — together with a pair of small capacitors to give it the correct resonating capacitance. So that's the reason for XTAL1, C14 and C15.

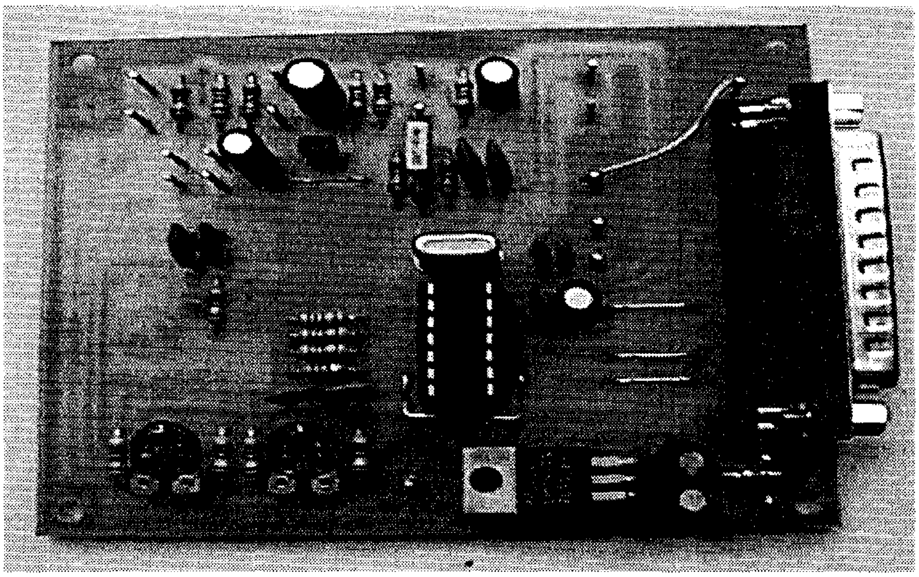
Note that since the STV5730A can also accept an external clock signal, it's possible to 'slave' a second chip by feeding it with the clock from an existing one. In fact I've provided two terminals on the PCB (labelled 'Xi' and 'Xo') to allow this to be done easily. To drive the second one you'd simply link its Xi terminal to the Xo pin on the main module.

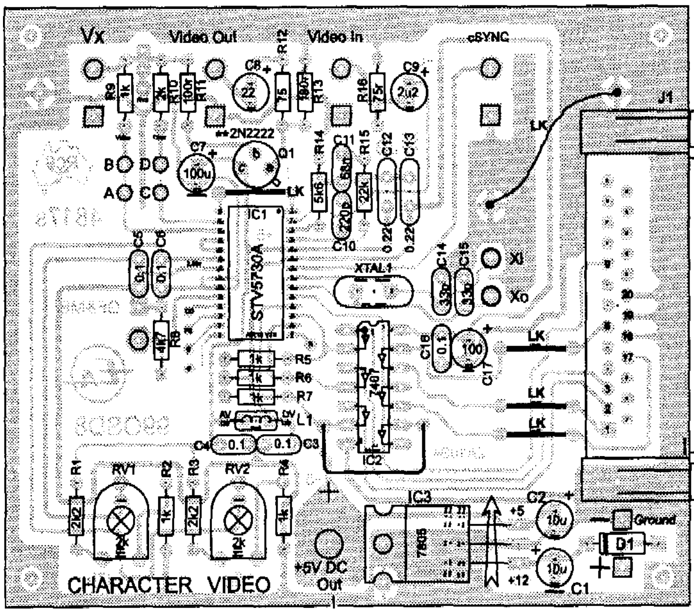
By the way components R14, R15, C10 and C11 seem to be part of the timing for the chip's internal PLL.

The video-plus-OSD text comes out of the chip via pins 26 and 27, and as you can see we combine these via resistors R9-R11, before feeding them through Q1 — a 2N2222 transistor serving as a simple video output buffer. Resistor R12 gives the correct 75Ω output impedance, while C8 ensures that there's no DC component fed out with the video.

Pins 22 and 23 on the chip are used to adjust the character and screen intensity levels, respectively, using DC control voltages. RV1 and RV2 are used to allow adjustment of these levels, so you can get the display to way you want it.

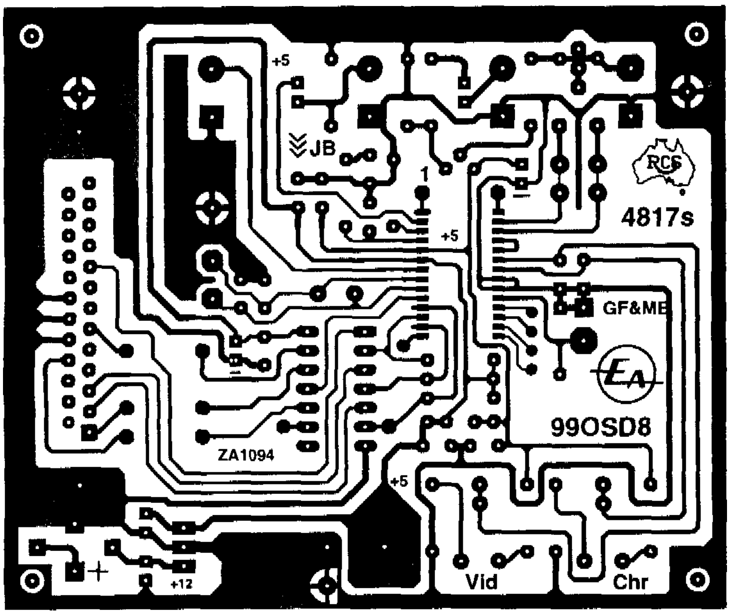
Now all we need to explain is the way that we get character information into





LK - Link

*** - See circuit diagram for transistor 2N2222 / PN2222 pinouts.*



The component overlay and the actual size PCB artwork.

IC1, from the PC via its printer port. That's the job done by IC2, a 7407 low cost TTL hex buffer chip.

Basically the STV5730A is designed for control via an I²C three-wire serial interface bus, using pins 11 (serial data input), 12 (serial data clock input) and 13 (serial chip select input). As you can see, these are simply fed from printer port pins 2, 9 and 3 respectively, via three of the buffers in IC2. As the 7407 buffers are of the open-collector type, they use 1k pullup resistors to drive the IC1 inputs correctly.

So that the PC software can tell when the module is connected to the printer port and 'alive', buffer IC2f is used to link pin 6 back to pin 1 for 'handshaking'. Also since the software needs to be able to tell when IC1 is being fed with valid composite video input, buffer IC2e is used to link the 'video present' output pin of the chip (pin 10) to pin 17 of the printer port connector.

That's about it, then. Everything fits on a small PCB measuring 96 x 80mm and coded 99osd8, with the DB25 connector mounted on one end. This is simply connected to the PC's printer port via a DB25 to DB25 extension cable.

Assembling it

First of all I recommend you inspect the PCB for shorts and open circuits, before you start assembly.

Then I suggest you populate the 5V regulated power supply, and perhaps solder in the DB25 connector and the five wire links shown in the PCB overlay diagram. The 'U' shaped link that runs around the end of IC2 is merely to stop the input of unused buffer IC2d from 'floating', so it can be left until a bit later if you wish (but don't forget it).

Now solder in all the other components, including the two trimpots and the 14-pin socket for the TTL 7407 IC. Take care with the polarised components, like the electros, diode and transistor Q1. The video in and out sockets are mounted off-board, but you might want to fit some short lengths of tinned or insulated copper wire, ready to make the connections when the board is complete and mounted on the optional metal bracket or whatever.

A word of caution here about the transistor, Q1. The PCB is marked according to the connections for a 2N2222 transis-

Resistor Colour Codes

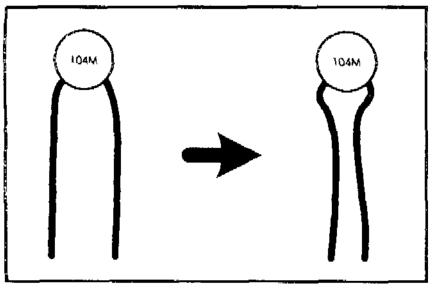
Value	4 Band (1%)	5 Band (1%)
75R	violet green black brown	violet green black gold brown
100R	brown black brown brown	brown black black black brown
180R	brown grey brown brown	brown grey black black brown
1K	brown black red brown	brown black black brown brown
2K	red black red brown	red black black brown brown
2.2K	red red red brown	red red black brown brown
4.7K	yellow violet red brown	yellow violet black brown brown
5.6K	green blue red brown	green blue black brown brown
22K	red red orange brown	red red black red brown

Capacitor Codes

Value	IEC Code	EIA Code
33pF	33p	33K
220pF	220p	221K
0.068uF	68n	683K
0.1uF	100n	104K
0.22uF	220n	224K
2.2uF	2u2	225K
10uF	10u	106K

Text and illustrations courtesy of Electronics Australia

tor; note that some plastic-cased PN2222 versions from un-named component suppliers have the emitter, base and collector connections are transposed, which can lead to problems if you don't notice. In any case a BC547, BC548 or similar can be substituted here without any problems...



A number of different style capacitors with differing lead spacing are used in circuit. Before inserting capacitors shape leads to suit PCB hole spacing. Example shown above. Mount capacitors as close as possible to PCB.

Do not solder the main surface-mount IC under the PCB as yet — be patient. First hook up the PCB to a source of nominal +12V DC power, and test the 5V regulator chip IC3, looking for the correct volts in and stability of volts out. I also suggest you check the supply voltage points around the circuit, taking special care that the DC voltages on the wipers of trimpots 1 and 2 can only be varied from about 0.95V up to around 2.88V. The voltages from these trimpots, applied to pins 22 and 23 of the soon-to-be-soldered-in surface mount IC, **must not exceed 3.0 volts** or 'the smoke will escape' and your most valuable IC will die soon after it's soldered in place.

Also check pads 5, 6, 11, 12 and 13 on those waiting for IC1 under the PCB, and ensure that +5V is present on these pads — but on none of the others except pin 22 and 23 will carry the trimpot wiper voltages. As the chip is fairly pricey, I suggest that you check all the voltage points around these PCB pads, and re-check. A mistake could be expensive!

By the way the first prototype built had a top ground plane for the purpose of limiting any RF transmission and/or picking up any RF — although as we are working at a nominal 1V p-p, the latter is less likely than the former. When building and trying out a second prototype using a single-sided PCB, all worked OK, especially if mounted in a simple metal enclosure to provide a measure of RF shielding.

Now with no obvious problems, it is time to bite the bullet. So turn off the power supply, ensure the PCB is fully grounded with no charged capacitors or static electricity. You can now insert the 7407 IC into its socket.

A quick turn-on of the power supply and you should be able to check that all appears to be well on the pins of this IC. Note that it's a hex buffer with no inversion, so a positive on any one of the input pins should result in the same at the corresponding output — except at pin 8, which doesn't have a pullup resistor as we're not using it.

Now if all pins appear to be correct, turn off the power supply, and wait for all electros to fully discharge (have a coffee — it may be cheaper than you think). Then taking note of pin 1, carefully solder in the special STV5730A surface mount IC under the board. I suggest tacking it in by soldering pin 1 to the corresponding PCB pad first, and if necessary re-heating this joint and 'nudging' the chip until its leads are sitting squarely over all of the other pads. Then you can quickly solder the others. The emphasis here is on taking great care, and even more care, not to damage the chip due to either overheating or static discharge. Also be careful where you place the PCB once the chip has been fitted, as a short from now on may well be very expensive.

Finally it's time to solder in the colour genlock crystal, too. Your OSD module should now be complete.

Final checkout

Note - Circuit is best suited to operate with 286 / 386 / 486 machines. May not work on high speed computers.

Now connect the video out to the direct (AV) video input of your TV or video monitor, or camera input of the VCR, etc. Then connect the DB25 connector up to the printer port of your PC, into which you've installed the demo software.

By the way the demo software runs under DOS and seems to have to be installed in a subdirectory called DATA. So make a directory of this name on your hard drive and copy the supplied file into it.

Now turn on the power supply to the module, and see what appears on the monitor. If all is well, you'll see some sort of video. It will probably be out of lock, but don't worry at this point; the STV5730A needs to be reset via the PC software, before everything locks into place.

Turn on the PC if it isn't already on, change to the DATA subdirectory and fire up the demo software by typing 'STV5730' followed by pressing the [Enter] key. Assuming the software finds your OSD module via the printer port and cable, it'll start up correctly and give you a simple menu with 10 options.

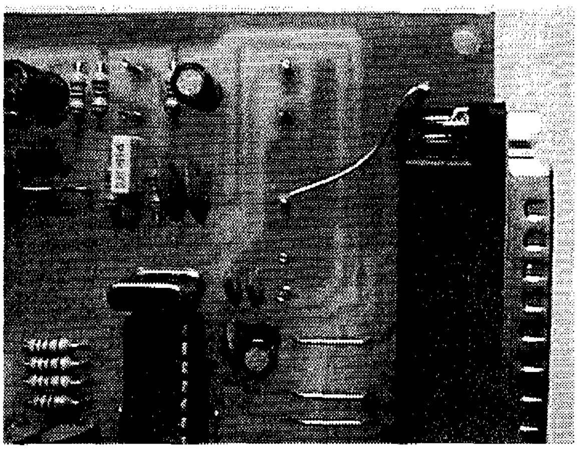
To initialise the STV5730A chip, press '5' and [Enter]. This performs a software reset. Then press '3' and [Enter], and you'll get a line requesting a 'context' file to download. If you type in INIT.DAT, followed by [Enter], the screen on the video monitor should clear after a second or two, and you should see a stable picture of your incoming video.

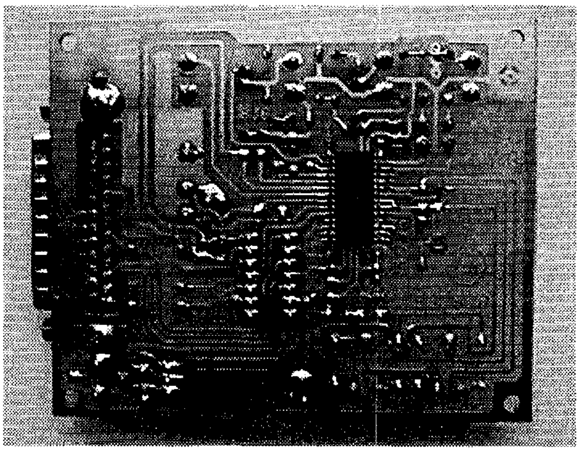
Now press '3' + [Enter] again, followed by DEMO1.DAT and [Enter] once more. You should now be rewarded by seeing a screen display like the screen grab of Fig.1, with the bottom 'OSD5730' line blinking impressively.

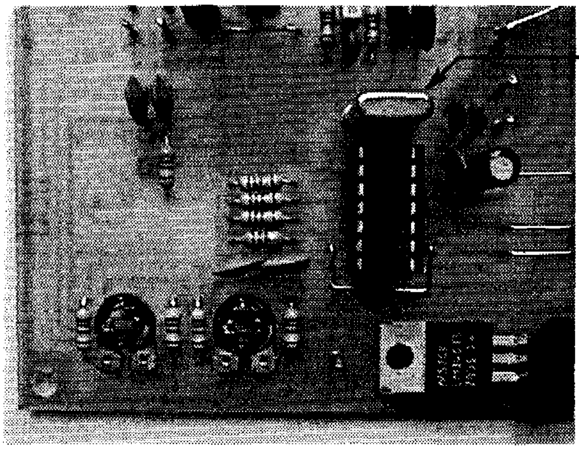
To see some of the other possibilities that the STV5730A chip can achieve, try keying in '3' + [Enter] again, followed by the name of the other 'demo context files' provided in the demo software — with names from DEMO2.DAT to DEMO6.DAT, and also CBAR1.DAT.

This demo software is very basic (read 'primitive'), but it should at least get you going. It's also dirt cheap, because as mentioned earlier you can download it from the ST Microelectronics website, and hopefully from the EA website as well. For those without web access, we have supplied a disk with the kit or for the cost of a floppy disk plus minor pack and post charges replacement disks are available from RCS Radio, of 651 Forest Road, Bexley 2207.

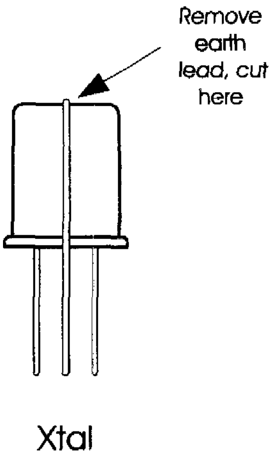
That's about it. The PCB has been designed for experimenters, and I also have several 'plug-ins' which have been built and tested — ask at RCS Radio for more details.



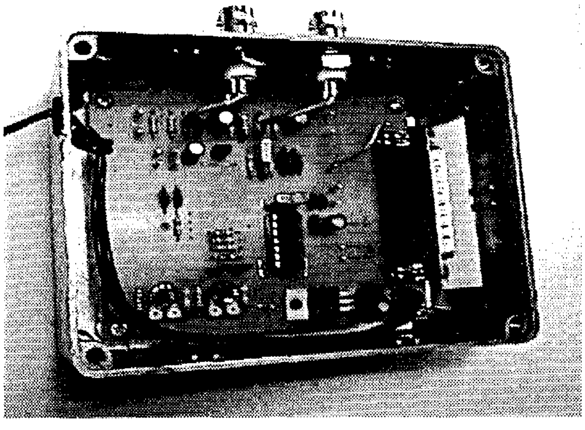




Note, some xtals may be supplied with an earth lead attached to the outer metal housing.
This earth lead is not required for the project and needs to be cut short.



Xtal



Shows how the PCB mounts into a suitable diecast box (H2204) with video in/out sockets mounted on case side. Note - diecast box, PCB mounting hardware & cable as shown in picture not supplied in the kit.

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